# United States Patent [19]

**Cordis, deceased et al.**

[11] **4,004,602**

[45] **Jan. 25, 1977**


[54] **SELF-METERING DUAL PROPORTIONER**


[75] Inventors: **Nat Cordis, deceased,** late of Silver Lake, Wis.; **by Gladys S. Cordis, executrix,** Chicago, Ill.

[73] Assignees: **Carl F. Jensen; Gerald T. Dobie,** both of Rosemont, Ill. ; part interest to each



[22] Filed: **June 11, 1973**

[21] Appl. No.: **368,619**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 111,100, Jan. 29, 1971, abandoned, which is a continuation of Ser. No. 14,798, March 2, 1970, abandoned, which is a continuation of Ser. No. 738,764, June 7, 1968, abandoned, which is a continuation of Ser. No. 504,254, Oct. 23, 1965, abandoned, which is a continuation-in-part of Ser. No. 111,992, May 23, 1961, Pat. No. 3,213,873, which is a continuation-in-part of Ser. No. 152,204, Nov. 14, 1961, Pat. No. 3,213,796, which is a continuation-in-part of Ser. No. 380,695, July 6, 1964, Pat. No. 3,291,066.

[52] **U.S. Cl.** ..... **137/99**

[51] **Int. Cl.²** ..... **G05D 11/03**

[58] **Field of Search** ..... 137/99, 540; 91/345, 91/447, 352; 92/133; 417/399, 400, 403, 404



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*Primary Examiner*—Robert G. Nilson
*Attorney, Agent, or Firm*—Everett A. Johnson



[57] **ABSTRACT**

There is here disclosed an apparatus for proportioning and blending a metered quantity of a first fluid, which provides the pumping power, with second fluids, the apparatus including an hydraulic motor, slave pump means having tandem pistons, and dual check valve assemblies associated with the slave pistons.


**4 Claims, 20 Drawing Figures**

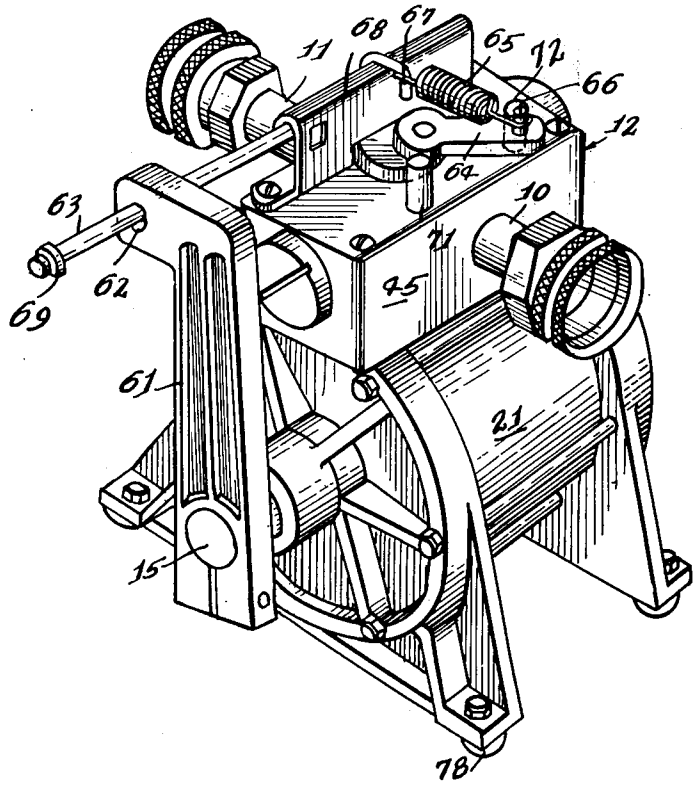


FIG. 1

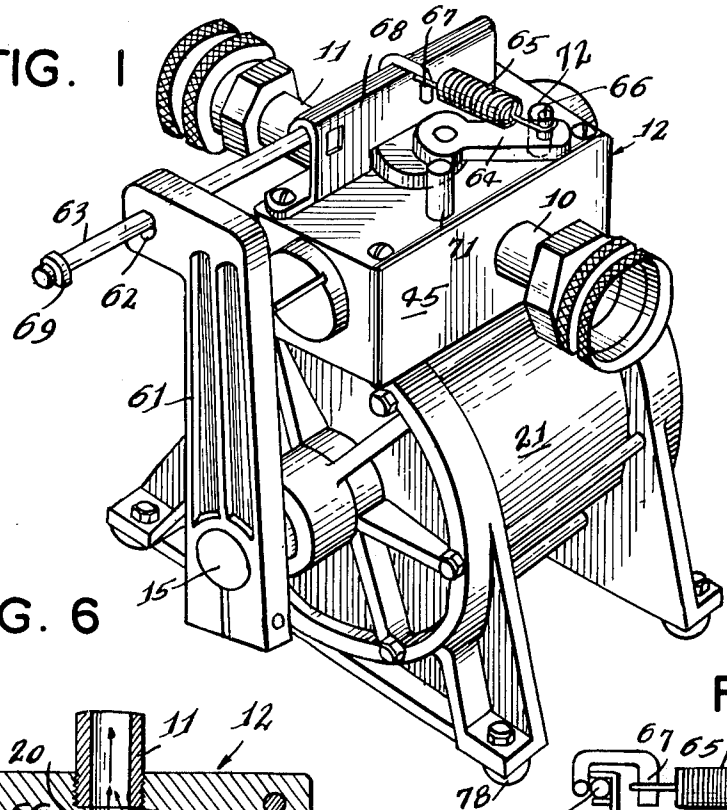



FIG. 6

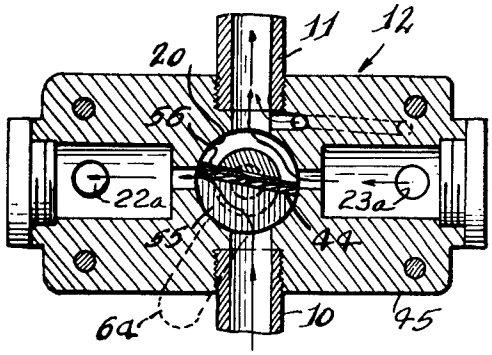



FIG. 7

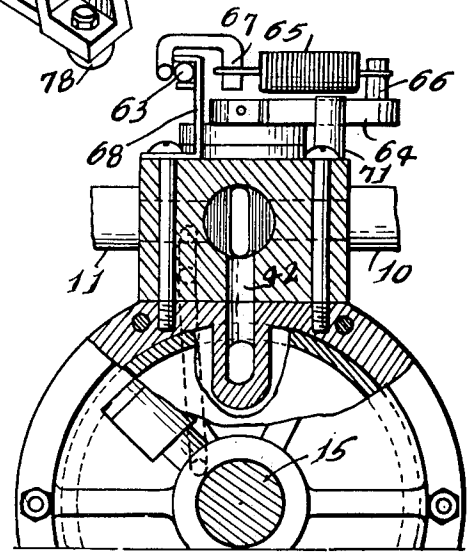



FIG. 8

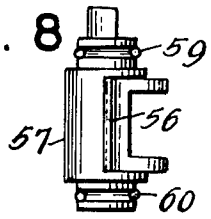



FIG. 10




FIG. 9

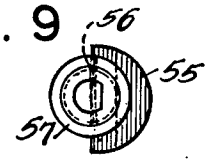



FIG. 11

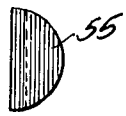


FIG. 4

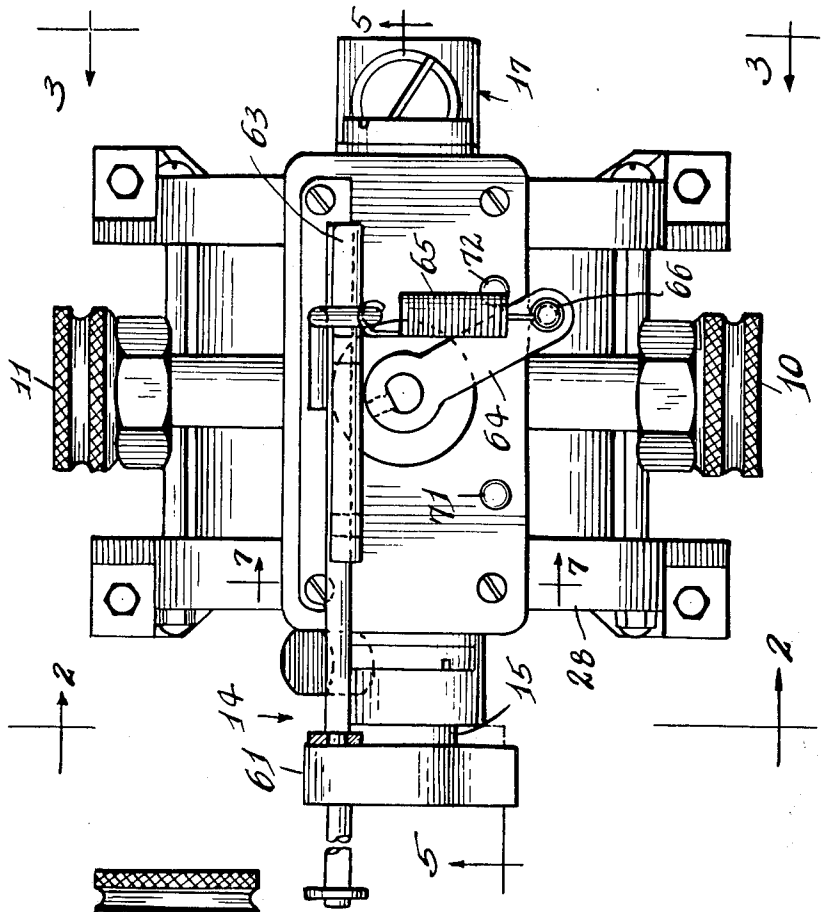

3
5
17
63
65
12
66
11
64
10
41
7
28
2
14
15
61

FIG. 2

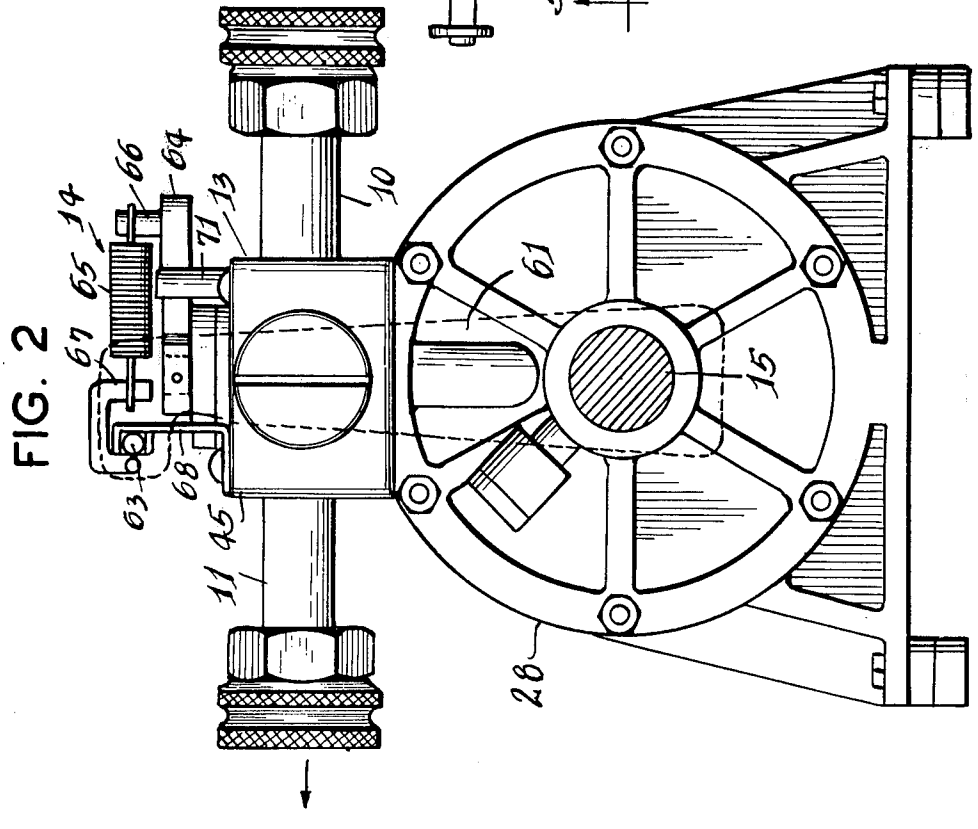

66
64
14
13
71
10
65
61
67
15
68
63
45
11
28

FIG. 3

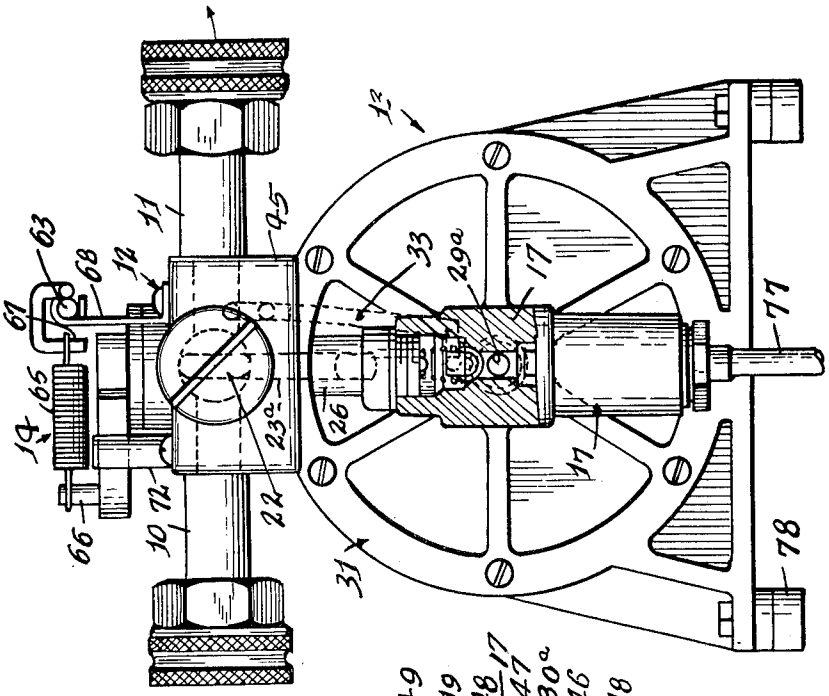
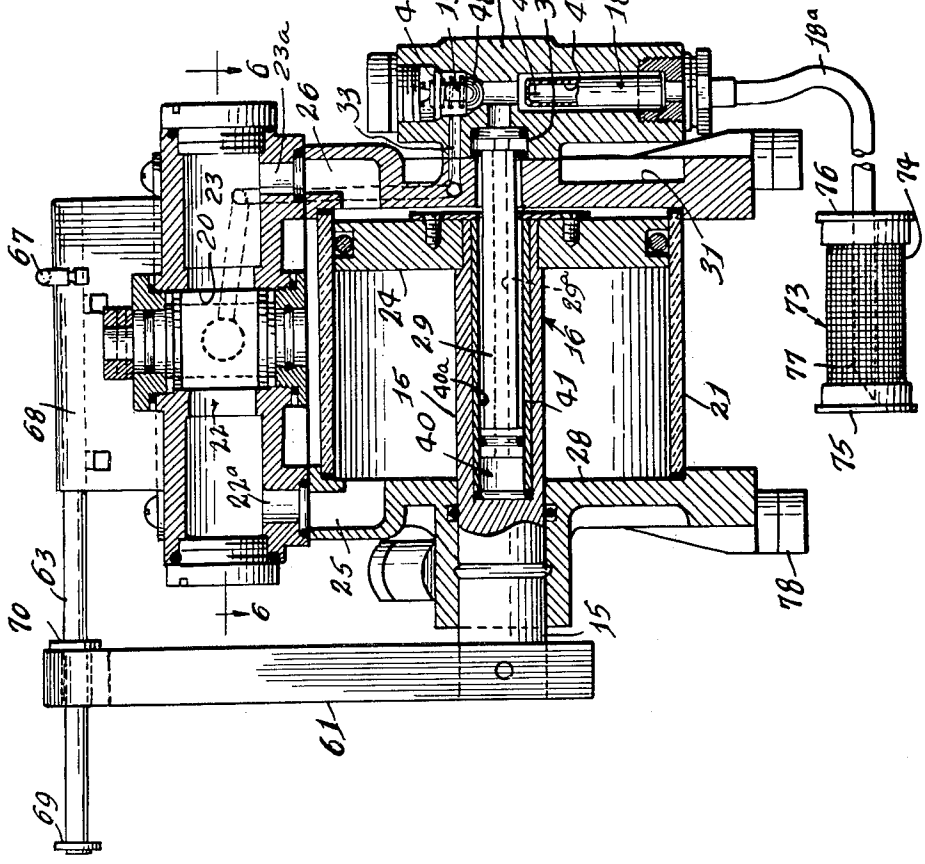


FIG. 5



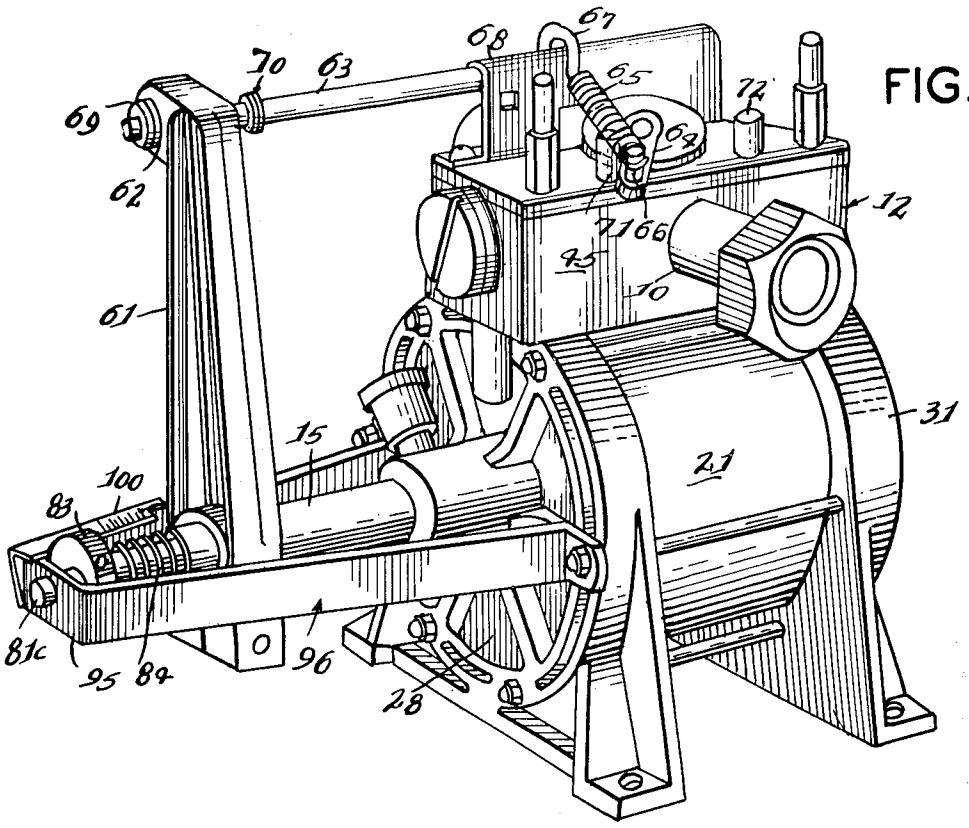

67
68
70
63
65
72
69
64
62
12
66
75
10
61
31
15
21
100
83
81c
95
84
96
28

FIG. 12

FIG. 13

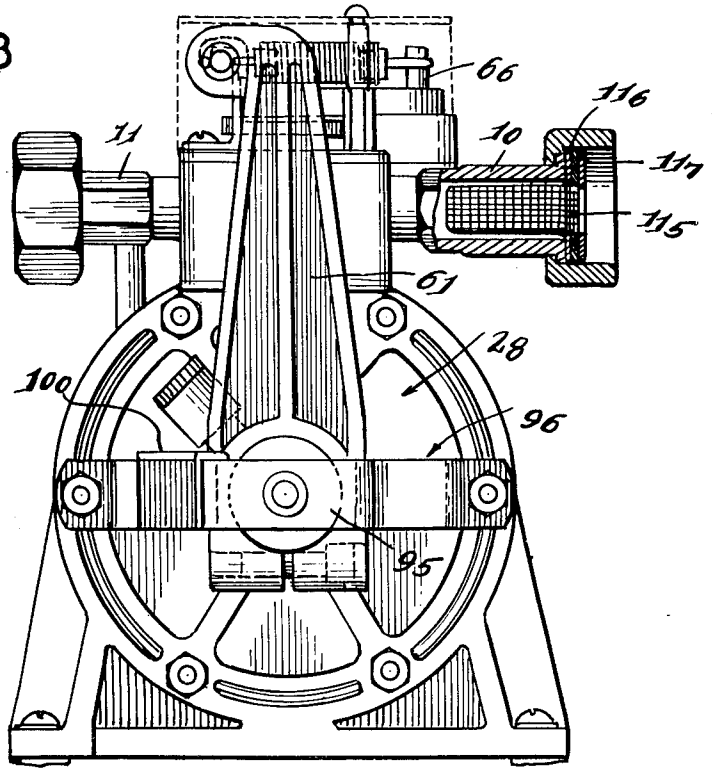

66
116
11
10
117
115
61
28
100
96
95

FIG. 14

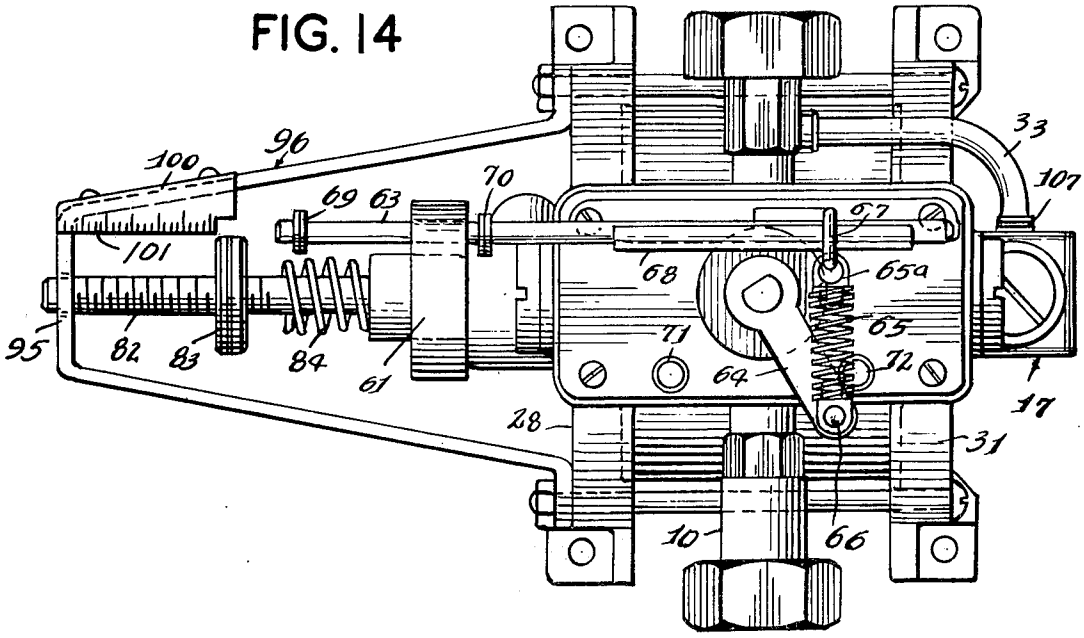

100
96
69
63
70
67
33
107
101
68
65a
65
71
64
72
17
95
82
83
84
61
28
31
10
66

FIG. 15

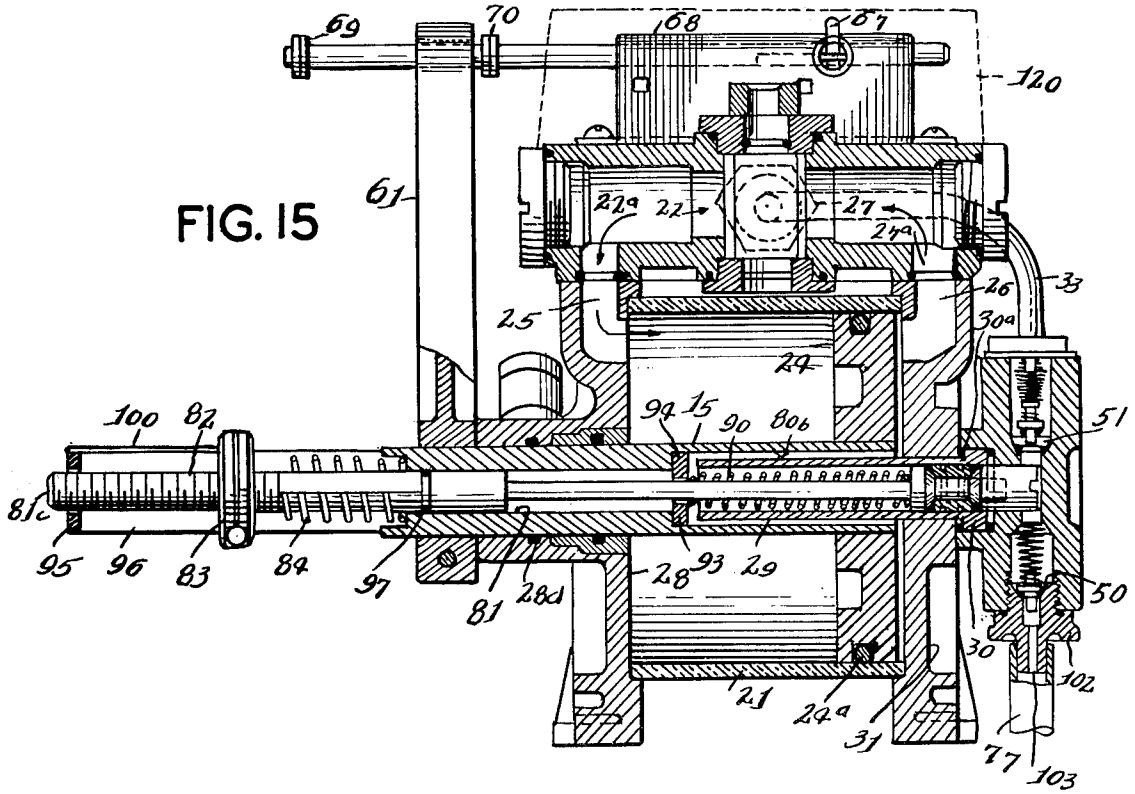

69
70
68
67
120
61
21a
22
27
24a
26
33
25
30a
24
100
82
94
15
90
80b
51
81c
95
96
83
84
97
81
28d
28
93
29
50
30
102
21
24a
31
77
103

FIG. 16

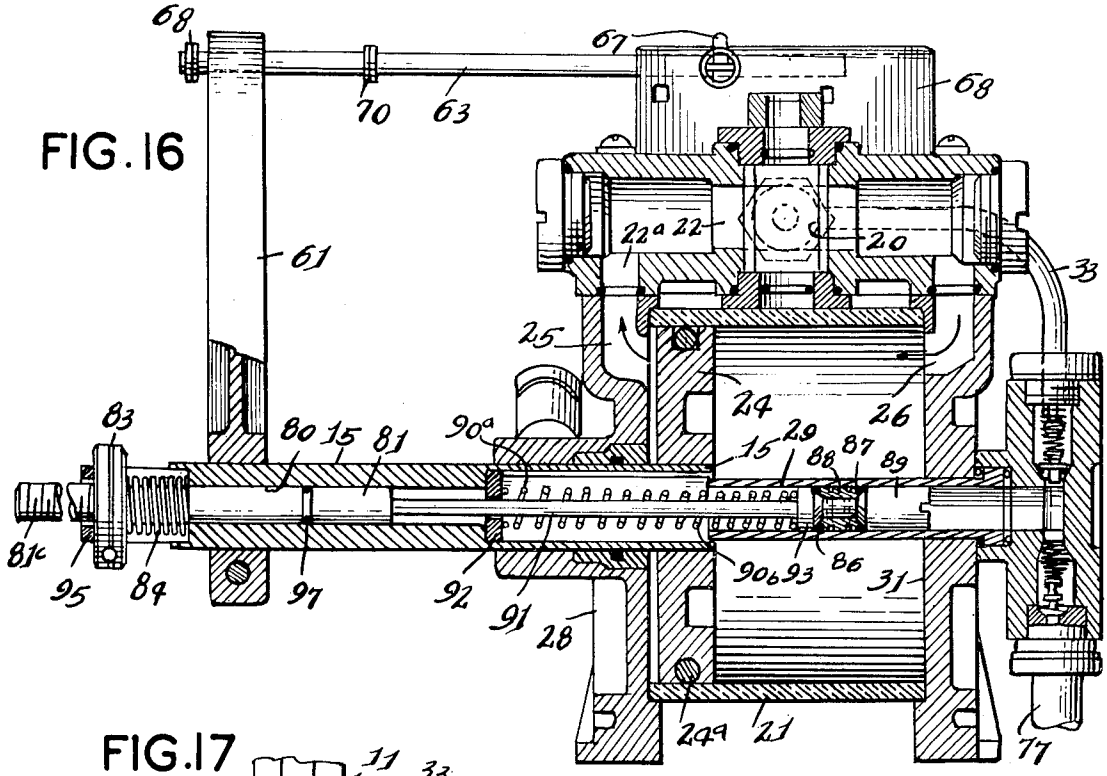



FIG. 17

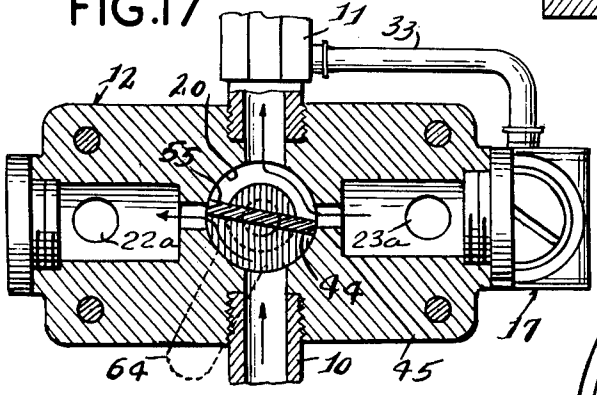



FIG. 18

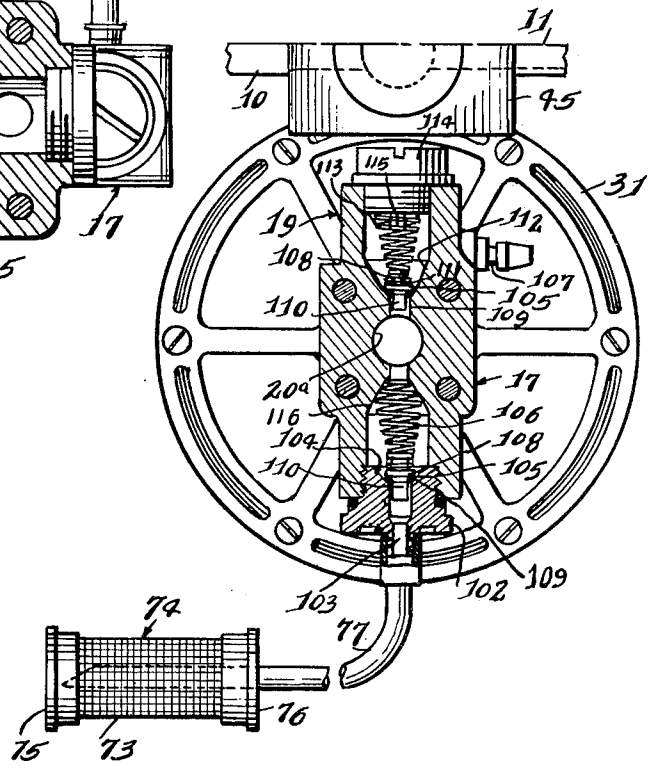


FIG. 19

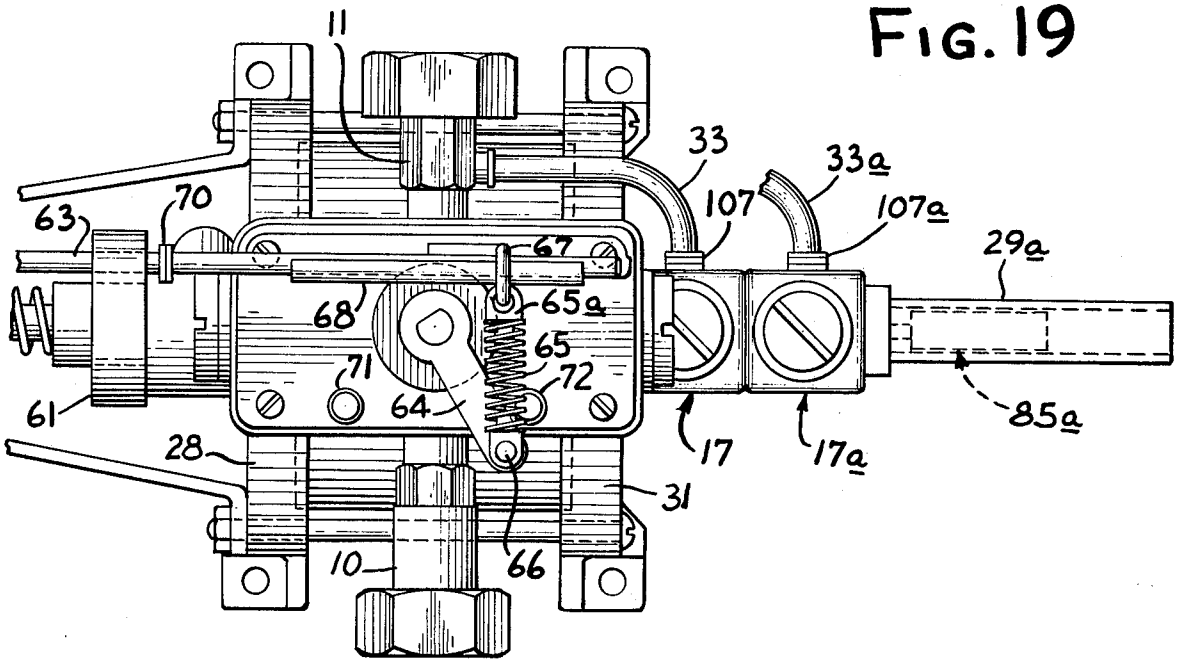
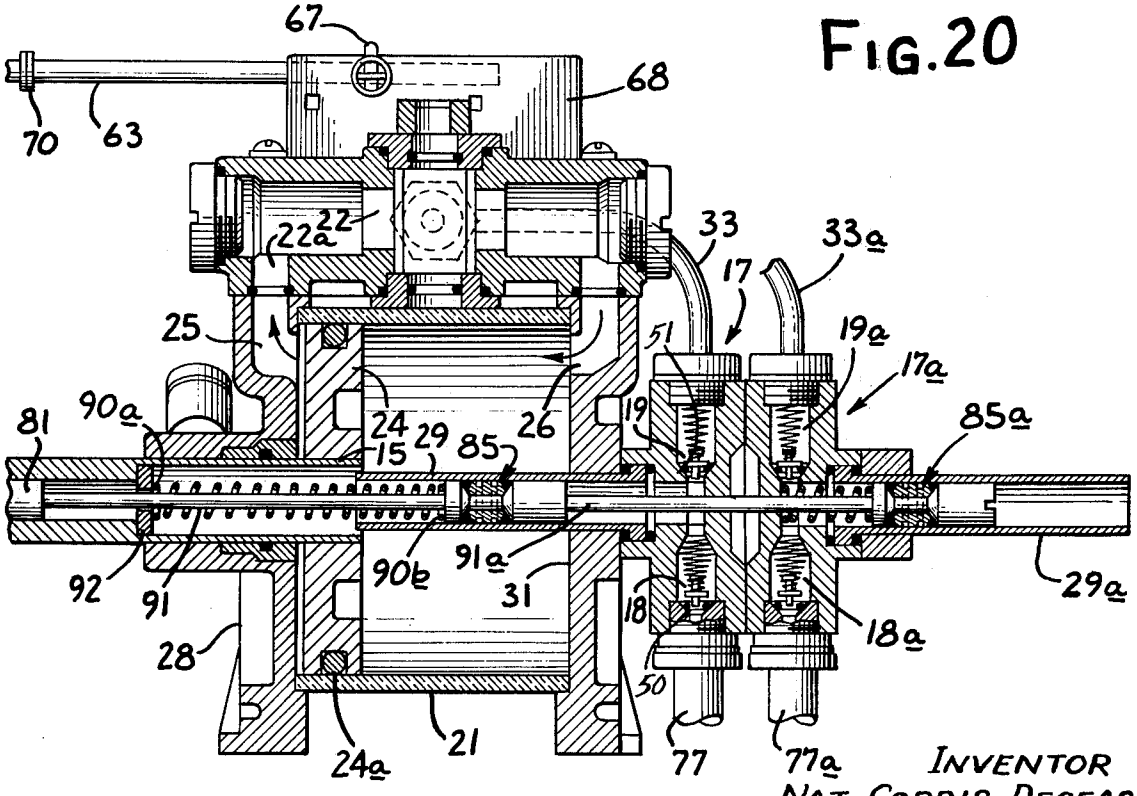



FIG. 20




INVENTOR
NAT CORDIS, DECEASED
GLADYS S. CORDIS, EXECUTOR

by: Everett A. Johnson
ATTY.

# SELF-METERING DUAL PROPORTIONER

This application is a continuation of copending application Ser. No. 111,100, filed Jan. 29, 1971, now abandoned, which in turn is a continuation of application Ser. No. 14,798, filed Mar. 2, 1970, and now abandoned, and of application Ser. No. 738,764, filed June 7, 1968, and now abandoned, and application Ser. No. 504,254, filed Oct. 23, 1965 and now abandoned, which in turn is a continuation in part of application Ser. No. 111,992, filed May 23, 1961 and issued as U.S. Pat. No. 3,213,873 and of application Ser. No. 152,204, filed Nov. 14, 1961 and issued as U.S. Pat. No. 3,213,796, and Ser. No. 380,695, filed July 6, 1964 and issued as U.S. Pat. No. 3,291,066.

This invention relates to a self-powered fluid proportioning apparatus of the type adapted for mixing a treating fluid with a raw fluid and discharging the fluids into a distribution means. More particularly, the invention relates to a system for medicating drinking water of live stock, including poultry, wherein a stream of water powers the apparatus.

Many types of equipment have heretofore been proposed for feeding one fluid, including drugs, vaccines, nutrients, sanitizing, deodorizing, and softening materials and the like into a second fluid stream such as water. Such prior systems, however, have been complicated in construction, unreliable in operation, cumbersome in use, not adapted for both portable and automatic continuous installation, or have not been self-powered.

A primary object of the invention is to provide a system for feeding a first fluid into a second fluid in selected proportions over a wide range of pressures and flow rates of the second fluid. An additional object of the invention is to provide an efficient and reliable device which is portable and rugged. Another object of the invention is to provide a system which requires no power for operating the apparatus other than the flowing stream being treated. It is a further object of the present invention to provide new and novel self-powered apparatus for continuously and automatically treating raw water streams with a fluid treating agent. It is also an object of the invention to provide an apparatus particularly adapted for use in medicating the drinking water of poultry and for delivering the treated water under pressure into the water distribution system, such as a system including drinking troughs having float-controlled inlet valves. These and other objects of the invention will become apparent as the description thereof proceeds.

Briefly, according to the present invention, we provide a self-propelled fluid blending or treating apparatus which includes a hydraulic master motor means operated by a primary raw fluid to be treated, a slave pump means for the treating fluid actuated by such motor, and a delivery manifold means through which the fluid used to operate the motor and the treating fluid from the slave pump are discharged. Such delivery manifold means may include a mixing chamber.

The slave pump and hydraulic motor comprise a unitary system wherein piston means in the hydraulic motor is provided with a cylindrical chamber reciprocatable along or over a fixed slave hollow pump plunger. A pumping chamber having check valve means communicates with the fixed hollow plunger and the treating agent and the water are discharged into the delivery manifold means wherein the fluids become intimately mixed. Details and advantages of the apparatus, in accordance with this invention, will be described by reference to the accompanying drawings wherein:

FIG. **1** is an elevation in perspective;

FIGS. **2** and **3** are opposite end elevations:

FIG. **4** is a top view;

FIG. **5** is a vertical section taken along the line **5—5** in FIG. **4;**

FIG. **6** is a section taken through the valve block along the line **6—6** in FIG. **5;**

FIG. **7** is a section taken along the line **7—7** in FIG. **4;**

FIGS. **8** through **11** illustrate details of the gating valve mechanism of FIGS. **5** and **6.**

FIG. **12** is an elevation in perspective;

FIG. **13** is an end elevation;

FIG. **14** is a top view;

FIGS. **15** and **16** are side elevations, partly in section;

FIG. **17** is a section through the upper valve block of FIGS. **15** and **16;**

FIG. **18** is an enlarged fragmentary end view showing details of the pump valve means of FIGS. **15** and **16;** and

FIGS. **19** and **20** are, respectively, a top view and a side elevation, partly in section of another embodiment of the invention.

Corresponding components in FIGS. **1–11** and in FIGS. **12–20** are designated by like reference numerals.

Referring to the drawings, the apparatus illustrated includes the water inlet **10,** the water outlet conduit **11,** the water-gating assembly **12,** the water motor **13,** connecting rod **15,** slave pump **16,** and treating agent valve chamber means **17** having inlet check valve **18** and outlet check valve **19.**

The water enters the valve chamber **20** in the water-gating assembly **12** through water inlet **10** and is gated into the motor body **21** via ports **22** or **23** to apply fluid pressure on alternate sides of the motor piston **24** via channel **25** or **26.** The slave pump **16** comprises a connecting rod **15** carried by the piston **24,** rod **15** passing through one end wall **28** of the motor body **21.** The tubular pump plunger **29** is mounted by an end flange **30** in the opposite wall **31** of the motor body **21** and is provided with the O-ring gaskets **30***a* on both sides of the flange **30,** as shown in FIG. **5.**

The slave pump check valve assembly **17** fixed to the end wall **31** contains the inlet and outlet check valves **18** and **19,** the inlet connection **32** and the outlet channel **33.** A bore **40** in an end of connecting rod **15** accommodates the fixed tubular pump plunger **29,** the cylinder **40** operating to-and-fro over the plunger **29** having O-ring **41** in response to the movement of the motor piston **24.** The cylinder **40** is preferably provided with glass liner **40***a.* The piston **24** is driven by the water entering the gating system **12,** to be expelled by the piston **24** alternately through channels **22***a* and **23***a,* shunt valve **55** and the water-gating assembly **12** which discharges through outlet conduit **11.**

When the connecting rod **15** moves the cylinder **40** away from the pumping plunger **29,** treating fluid is drawn into the treating agent valve assembly **17** through the "open" inlet check valve **18** and at the same time the suction produced by the withdrawal of the cylinder **40** about the hollow plunger **29** closes the outlet check valve **19,** which when subsequently opened discharges through the manifold block **45** via channel **33** and outlet conduit **11.**

When the direction of travel of the pumping cylinder **40** is reversed over the hollow plunger **29** in following the motion of the motor piston **24** through the rigid connecting rod **15**, the inlet check valve **18** closes and the outlet check valve **19** opens so that the treating fluid trapped in the pumping barrel **29***a* within plunger **29** and cylinder **40** is ejected under pressure into outlet conduit **11** via channel **33**. The water and medication leave the water-gating assembly **12** in a proportion based upon the displacement volume of the slave pump **16** and the volume of the motor chamber **21** on either side of the motor piston **24**. The proportions of raw fluid (water) to treating agent (drug) can be preadjusted by selection of the dimensions of bore **40**, barrel **29***a*, etc.

If desired, a multiplicity of check valve-pump assemblies may be provided and actuated by the water motor **13**. In this way several types of treating agents or additives may be blended with the water at the same time.

The pumping valve assembly **17** houses the inlet check valve **18** and the outlet valve **19**. The inlet check valve **18** comprises a deformable hollow cylinder **46** having a self-closing port **47**. The outlet check valve **19** comprises a plug **48** held by spring **49** against the valve seat **50**. A delivery channel **51** communicates with the valve block **17** above the spring-loaded plug **48** and discharges by channel **33** into the outlet conduit **11**.

The slave pump **16** includes the connecting rod **15** for piston **24** with its pump cylinder bore **40**. The treating fluid plunger **29** is tubular with an internal pumping channel **29***a*. An O-ring **41** on the free end of the pumping plunger **29** engages the wall of the pump cylinder **40** to provide a pumping seal.

On a suction stroke of the pumping cylinder **40** the elastic cylinder **46** of inlet check valve **18** expands to open the port **47**; and the plug **48** on the outlet check valve **19** is held over the outlet port **19***a*. When the pumping cylinder **40** is on the ejection stroke, this situation is reversed so that the plug **48** is lifted and the port **47** in cylinder **46** is closed.

The gating assembly **12** includes a valve plug **55**, the valve leaf spring **56**, and the valve shaft **57** disposed within the valve chamber in the valve block **45**. These components are shown in detail and in subassembly by FIGS. **6** through **11** in the drawings. In FIG. **6**, the valve block **45** is shown in cross-section and illustrates the alternate positions of plug **55** and flows through the channeled block.

Opposite ends of the valve shaft **57** are provided with O-rings **59** and **60** to effect a fluid-tight seal. The valve plug **55** is shifted from two extreme positions, alternately closing and exposing the ports **22** and **23** leading to channels **22***a* and **23***a*, respectively, which direct the flowing fluid to opposite sides of the motor piston **24**.

The connecting rod **15** projects through the end wall **28** and supports the actuating arm **61** which terminates at its upper end in a bore **62** through which the reversing rod **63** passes. A pair of C-rings **69** and **70** on the reversing rod **63** comprise travel stops contacted by the arm **61** for shuttling the reversing rod **63** between its positions.

The upper end of the valve shaft **57** is provided with a toggle lever **64** which is actuated by coil spring **65** anchored at one end to the post **66** carried by the free end of toggle lever **64**, and is anchored at its other end by the inverted post **67** which is fixed to the shiftable reversing rod **63** which is slidably carried within the guide **68** secured to the water-gating assembly **12**.

When the actuating arm **61** contacts either of the stops **69** or **70**, the movement of the actuating arm **61** is imparted to the reversing rod **63** which in turn shifts the spring anchor post **67** with the result that the spring **65** swings about the post **66** carried by the toggle lever **64** until there has been sufficient travel thereof to shift the toggle lever **64** by the action of the spring **65**. When this occurs, the valve shaft **57** is rotated and referring to FIG. **6** moves the valve plug **55** to one of two diverting position. The travel or throw of the free end of the toggle lever **64** is controlled and restricted by posts **71** and **72** fixed to the water-gating assembly **12**.

As the piston **24** travels in the motor cylinder **21** the connecting rod **15** carries the actuating arm **61** with it causing the toggle lever **64** to pivot between the two positions determined by the posts **71** and **72**. At the limits of travel of the reversing rod **63**, the shunt valve **55** is placed in the alternate positions as shown in the drawings. This causes the water to course through the channels **42** or **43** leading to the opposite sides of the piston **24** thereby displacing the piston **24** to opposite ends of the motor cylinder **21** and actuating the slave pump **16** as described.

A further embodiment of the apparatus which is variable, is provided with an adjustable slave pump head, and includes substantially identical opposed check valves as illustrated in the drawings.

The motor piston **24** within motor cylinder **21** has tubular connecting rod **15** fixed to it and projecting axially of end wall **28**. The connecting rod **15** contains bore **80** accommodating the adjustable shaft **81**, which includes the threaded portion **82**, the adjustment nut **83**, the balancing spring **84** about the shaft **81**, the slave pump plunger head **85**. The head **85** has O-rings **86** and **87**, the expandable chevron seal **88**, and threaded end plug **89** which is drawn up on the shaft, with the O-rings expanding the chevron seal **88** for the proper draw in the pumping barrel **29**.

The spring **90**, arranged about the constricted portion **91** of the shaft **81**, has one end **90***a* abutting the plunger shoulder **92** and the other end **90***b* acting against collar **93** floating on the shaft **81** to abut shoulder **94** within the bore **80** in propelling slave plunger head **85** after compressing spring **90**. The slave pump plunger head **85** operates within the cantilever-mounted slave pumping barrel **29** which is extendable within the chamber **80***b*. The exposed end **81***c* of the shaft **81** has its threaded portion **82** extending through stop yoke **95**, forming part of the bracket **96** fixed to the end plate **28** of the motor housing **21**. The adjustment of the above components determines the time lag in the operation of the slave pump in relation to the travel of the piston **24**. Thus adjusting proportioning nut **83** to one extreme of its travel abuts the stop yoke **95** which is the minimum or decreased proportion position.

Moving the proportioning nut **83** outwardly of the end **81***c* of the shaft **81** decreases the proportion delivered by the slave pump **16**, and positioning the proportioning nut **83** inwardly of the yoke **95**, to contact spring **84**, increases the quantity of the fluid delivered by the slave pump **16**; in these adjustments the lengths of springs **84** and **90** are altered whereby the necessary movement of the piston **24** to actuate the slave plunger **40** in suction and delivery strokes is adjusted. However, a pre-set lost motion linkage may be used.

The shaft **81** within the bore **80** in the connecting rod **15** is fluid-sealed by an O-ring **97**. The hollow shaft or

rod **15** with its cylindrical chambers **80***a*, **80***b* and **80***c* accommodating the spring **90**, the shaft **81** having threaded portion **82** on which the proportioning nut **83** runs and axially adjusts the delayed projection and retraction of the slave plunger, when taken together comprise an adjustable connecting rod means **15** by which the motion of the motor piston **24** is imparted to the slave plunger head **85** relative to the cantilever pump barrel **29** which is axially aligned with the connecting rod **15** and reciprocates therewithin.

A proportioning scale **100** may be carried by the bracket **96** with indicia **101** thereon correlated with the settings of the proportioning nut **83**, whereby selected proportions of raw power fluid, such as water, and of the treating fluid delivered by the slave pump **16** are selected and blended.

Thus there is provided a system for treating or blending fluids in selected variable proportions. However, a fixed ratio proportioner is contemplated which may be a composite of components from the illustrated apparatus. Thus, the apparatus includes a fluid motor comprising a cylinder, a piston, a piston connecting rod means **15** for power take-off, and a fluid gating means **12** in combination with a slave pump means **16** comprising a treating fluid valving means, a slave pump barrel projecting axially of the motor cylinder, a slave plunger means carried within the slave pump barrel which communicates with the treating fluid valving means. Slave pump plunger adjusting means may be provided exterior of the motor housing whereby the proportions of raw fluid and treating fluid blended therewith can be varied, even during operation of the device.

A novel check valve assembly **17**, shown in detail by FIGS. **15**, **16**, and **18**, includes, a lower inlet check valve plug **46**, a lower valve screw cap **102** having an inlet channel **103** and a tapered plug seat **104**. The inlet to check valve assembly **17** includes a plug **46** having a body portion **105** and a double-coned spring **106** extending between the plug **18** and the tapered seat **116**. A transverse chamber **20***a* comprises an extension of the pumping channel **29***a* in the slave cylinder **29**, and the plug **89** on the end of the slave plunger **40** projects into chamber **20***a* on each ejection stroke to displace all fluids from the assembly **17** through the outlet check valve **19** and discharge them via nipple **107**, line **33**, and outlet conduit **11**.

The upper end of the discharge valve cavity **113** is closed by screw cap **114** having an axial inward projection **115**. Outlet poppet plug **48** comprises a body portion **105** having an upper axial projection **108**, an O-ring seal **109**, and a depending guide stem **110**. A tapered or double coned spring **111** engages the axial projections **115** and **108** and urges the O-ring **109** on plug **48** against the tapered seat **51**. The lower inlet poppet valve plug **46** comprises corresponding components; however, it will be understood that the normally closed check valves **18** and **19** are in opposed array so that the inlet valve **18** opens on the suction stroke (with **19** closed) and the outlet valve **19** opens (with **18** closed) on the delivery stroke.

In operation, the intake assembly **73** connected to the inlet end of the conduit **77** is placed within a vessel containing the treating agent. The assembly **73** includes a cylindrical strainer screen **74** and two end plates or caps **75** and **76**, one of which is provided with a port to receive the tubing or conduit **77**. The assembly may be weighted with a ball bearing or the like so as to assure that the inlet end of the conduit **77** remains near the bottom of the vessel.

Reverting to the possibility of multiple slave pump/-check valves assemblies, it is apparent that two or more heads **85** can be arranged axially in tandem on the rod **81** with an additional check valve assembly **17** and pumping cylinder. When the check valve blocks **17** are arranged back-to-back, the delivery to outlet conduit **11** through lines **33** and **33***a* will be continuous and alternately from the two pump assemblies in such an array.

Referring to FIGS. **19** and **20**, the slave plunger means comprises a pair of axially spaced plunger heads **85** and **85***a* carried by slave plunger rod **81**, each with its own check valve assembly **17** and **17***a*; and each such assembly discharges through its own outlet lines **33** and **33***a* into the outlet conduit **11**.

In operation the plunger heads **85** and **85***a* alternately actuate inlet valve **18** of assembly **17** and outlet check valve **19***a* of assembly **17***a*; and outlet check valve **19** and inlet check valve **18***a* as described herein with reference to FIGS. **14**, **15**, **16**, and **18**.

As described herein, mixed fluids are discharged from the outlet conduit **11**. If desired, an auxiliary mixing chamber (not shown) may be provided but ordinarily this is not necessary, the proportioner providing adequate agitation and mixing of fluids.

The accompanying drawings show numerous details of construction which have not been designated by individual reference numerals. However, it will be apparent to one skilled in the art that such details, including grease cups, hose connectors, screws, etc. are conventional and need not be described in detail.

Materials of construction will be selected to be compatible with the fluids. For example, with corrosive treating agents stainless steel or nylon pumping plunger head **85** may be used in a glass or stainless steel pumping barrel, and the check valves **18** and **19** in assembly **17** may be of plastic or stainless steel. Other metals provided with ceramic or plastic coatings may also be used.

Although the invention has been described with reference to particular embodiments thereof, it should be understood that this is by way of illustration only and that modifications therein may be made in view of the teachings without departing from the spirit and scope of the invention.

What is claimed is:

**1.** A unitary self-metering multifluid proportioning apparatus comprising constant displacement hydraulic motor means including a housing having first and second end walls; master piston means operating within said housing; a connecting rod carried by the master piston means and passing through the first end wall of the housing; constant displacement slave pump means carried by said second end wall and including a tubular pump cylinder mounted in the said second end wall; a slave plunger axially aligned with said master piston means and operating within said tubular pump cylinder; said slave plunger means being in driven association with said connecting rod; a water supply inlet and delivery conduit means connected to said housing; a water gating assembly on said housing interposed said water supply inlet and said motor means gating water to alternate sides of said master piston means operating within said housing; spring loaded lever means mounted on said water gating assembly and linked to a reversing rod; linkage means between the connecting

rod and the said reversing rod whereby the reversing rod and the slave plunger follow the reversible motion of the master piston means; a flow control within said water gating assembly shifted by said spring loaded lever means; and slave pump check valve assembly means supported by the said second end wall and containing an inlet connection, and an outlet conduit means, said outlet conduit means discharging additive fluid directly into said delivery conduit means; and wherein said slave pump check valve assembly comprises a valve means carrying a plug on its upstream side and a self-centering, flow-through, double-coned coil spring on its downstream side, said double-coned spring having tapered end portions and an intermediate enlarged portion of maximum coil girth, and a ported bridge wall across the flow path through said slave pump check valve, a tapered recess on the upstream side of said bridge wall and terminating in a port therein, said tapered recess receiving and aligning the downstream cone end of said coil spring.

**2.** A unitary self-metering multifluid proportioning apparatus comprising constant displacement hydraulic motor means including a housing having first and second end walls; master piston means operating within said housing; a connecting rod carried by the master piston means and passing through the first end wall of the housing; constant displacement slave pump means carried by said second end wall and including a tubular pump cylinder mounted in the said second end wall; a slave plunger axially aligned with said master piston means and operating within said tubular pump cylinder; said slave plunger means being in driven association with said connecting rod; a water supply inlet and delivery conduit means connected to said housing; a water gating assembly on said housing interposed said water supply inlet and said motor means gating water to alternate sides of said master piston means operating within said housing; spring loaded lever means mounted on said water gating assembly and linked to a reversing rod; linkage means between the connecting rod and the said reversing rod whereby the reversing rod and the slave plunger follow the reversible motion of the master piston means; a flow control within said water gating assembly shifted by said spring loaded lever means; slave pump check valve assembly means supported by the said second end wall and containing an inlet connection; outlet conduit means, said outlet conduit means discharging additive fluid directly into said delivery conduit means; said tubular pump cylinder extending axially within said housing from said second end wall, said slave plunger comprising axially spaced dual plunger heads operating within said tubular pump cylinder; and said slave pump check valve assembly means comprising two inlet and outlet check valve assemblies operatively associated with said plunger heads, each outlet of said inlet and outlet check valve assemblies discharging separately through said outlet conduit means.

**3.** A self-metering dual proportioning apparatus for multiple fluids which comprises fluid supply conduit means, constant displacement master hydraulic motor means including a motor cylinder to which said fluid supply conduit means is connected through a fluid gating assembly on said motor means interposed said fluid supply inlet and said motor cylinder, displacement slave pump means, delivery conduit means, said slave pump means and said master motor means separately discharging into said delivery conduit means to provide a proportioned mixture of fluids flowing separately from said motor means and flowing from said slave pump means, said slave pump means comprising a fixed tubular pumping chamber, master piston means in said motor means, and a connecting rod, said fixed tubular pumping chamber being mounted through an end wall of said motor means within said motor cylinder in axial alignment with said master piston means, slave plunger means reciprocating in said tubular pumping chamber, said slave plunger means being in driven association with said connecting rod and projecting through the master piston means as said master piston means traverses the motor cylinder from end to end and as said slave plunger means is operated within said fixed tubular pumping chamber; said tubular pumping chamber extending axially from said motor cylinder through said end wall and said slave plunger means including a pair of spaced heads; and separate inlet and outlet check valve assemblies on said tubular pumping chamber extension with a ported wall between said assemblies and separating said heads.

**4.** The self-metering dual proportioner of claim **3** wherein said motor means includes a spring delayed linkage between the master piston means and the slave plunger means.

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